A Global Licensing and Regulation Framework for Fusion Energy

Ralf Kaiser, Holger Rogner, Adnan Shihab-Eldin, Sehila Gonzalez de Vicente

Fusion energy has the potential to have a major impact on achieving the goals of the Paris Agreement and contribute significantly to meeting growing global energy demand, if it is commercialised and deployed by 2040 and then scaled up as quickly as possible. One of the key factors to this is licensing and regulation that could impede a quick deployment, but it is a factor that can be addressed well in advance, before construction starts of the first fusion power plants. It also is a factor that is in principle within our control.

Most recent timelines agree on the second half of the 2030s for the realisation of a fusion energy pilot plant. The new official US Fusion Energy Strategy is to 'realize a commercially relevant, private sector-led fusion pilot plant in the 2030s, followed by commercial fusion deployment scale-up throughout the 2040s'. Japan has revised its policy in 2024 to include power generation demonstration from fusion in the 2030s. A survey by the Fusion Industry Association indicated that 26 of the 37 private fusion companies surveyed believe that the first fusion plant will start delivering electricity to the grid by 2035. Most recently, Commonwealth Fusion Systems announced an agreement with Dominion Energy Virginia to build its ARC fusion power plant in Virginia in the early 2030s.

Every nuclear engineering student learns that the essential parts of a nuclear fission reactor are fissile material, a moderator, control rods and a cooling system. A fusion power plant has none of the critical parts of a fission reactor just described. In fact, the key components of a magnetic confinement fusion power plant are the same as those of a modern particle accelerator. It therefore makes very perfect sense to regulate fusion power plants like particle accelerators, rather than like fission reactors. Inertial fusion and magneto-inertial fusion are slightly different and may utilize powerful lasers instead of large magnets. However, also they do not contain any of the basic components of fission reactors. In particular, they have no inventory of fissile material.

All major economies have established programmes to support the development of fusion energy, with recent new programmes in public-private partnerships established in the US, Germany, Japan and the UK. However, the largest growth in energy use in the coming decades is not expected in these countries, but instead in the developing world. With the exception of China and India, none of the countries in the developing world have any access to fusion technology. Deployment of fusion energy on a large scale in developing countries will only be successful if the developing world is included and part of the process from the beginning.

This paper makes the case for a Global Licensing and Regulation Framework for Fusion Energy, shows examples from other fields that demonstrate that this is feasible and develops a 7-point plan for such a framework. Key components of this plan are the creation of a Global Organisation for Fusion Energy, a core agreement in conjunction with a global network of agreements, a global regulator and global safeguards. This paper will show how the different components of the 7-point plan work together to accelerate the deployment of fusion energy on a global scale.